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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No.	EV354969445US

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
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Additional inventors are being named on the _____ separately numbered sheets attached hereto

TITLE OF THE INVENTION (500 characters max)

Method and System for Calculating and Reporting Slump in Delivery Vehicles

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

[✔] Customer Number: | 26875

OR

[ ] Firm or Individual Name	
Address	
Address	
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ENCLOSED APPLICATION PARTS (check all that apply)

[✔] Specification *Number of Pages* 17 (including 1 page abstract)

[✔] Drawing(s) *Number of Sheets* 1 (3 total figures)

[ ] Application Data Sheet. See 37 CFR 1.76

[ ] CD(s), Number _____

[✔] Other (specify) Transmittal (in duplicate containing Certificate of Mailing - 37 CFR 1.10) Reply Postcard

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

[ ] Applicant claims small entity status. See 37 CFR 1.27.

[✔] A check or money order is enclosed to cover the filing fees.

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[ ] Payment by credit card. Form PTO-2038 is attached.

FILING FEE
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

[✔] No.

[ ] Yes, the name of the U.S. Government agency and the Government contract number are: _____

[Page 1 of 1]

Respectfully submitted,

SIGNATURE _____

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	John I. Compton and Michael Topputo
Filed	:	February 13, 2004
For	:	METHOD AND SYSTEM FOR CALCULATING AND REPORTING SLUMP IN DELIVERY VEHICLES

TRANSMITTAL

Mail Stop PROVISIONAL APPLICATION
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Sir:

We are transmitting herewith the attached:

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> Provisional Patent Application Cover Sheet (1 page)
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By Kenneth Eads

METHOD AND SYSTEM FOR CALCULATING AND REPORTING SLUMP IN DELIVERY VEHICLES

Field of the Invention

The present invention generally relates to delivery vehicles and

particularly to mobile concrete mixing trucks that mix and deliver concrete.

More specifically, the present invention relates to the calculation and

5   reporting of slump using sensors associated with a concrete truck.

Background of the Invention

Hitherto it has been known to use mobile concrete mixing trucks to

mix concrete and to deliver that concrete to a site where the concrete may

be required. Generally, the particulate concrete ingredients are loaded at a

10   central depot. A certain amount of liquid component may be added at the

central depot. Generally the liquid component is added by simply holding a

hose or similar into the mixing barrel of the mobile concrete mixing truck.

Operators can tell by experience the correct or approximate volume of liquid

component each as water to be added according to the volume of the

particulate concrete ingredients. The adding of the correct amount of liquid component is therefore usually not precise.

It is known, that if concrete is mixed with excess liquid component, the resulting concrete mix does not dry with the required structural

5   strength. Accordingly, slump tests have been devised so that a sample of the concrete mix can be tested with a slump test prior to actual usage on site. Thus, if a concrete mixing truck should deliver a concrete mix to a site, and the mix does not have sufficient liquid component, extra liquid component can be added into the mixing barrel of the concrete mixing truck

10   to produce a required slump in a test sample prior to actual delivery of the full contents of the mixing barrel. If excess water is added, the mix will fail the slump test. A problem then exists because it is necessary for the concrete mixing truck to return to the depot in order to add extra particulate concrete ingredients to correct the problem. If these extra particulate

15   ingredients are not added within a relatively short time period after excessive liquid component has been added, then the mix will still not dry with the required strength.

In addition, if excess liquid component has been added, the customer cannot be charged an extra amount for return of the concrete mixing track

20   to the central depot for adding additional particulate concrete ingredients to correct the problem. This, in turn, means that the concrete supply company is not producing concrete economically.

One method and apparatus for mixing concrete in a concrete mixing device to a specified slump is disclosed in U.S. Patent No. 5,713,663 (the

'663 patent), the disclosure of which is hereby incorporated herein by reference. This method and apparatus recognizes that the actual driving force to rotate a mixing barrel filled with particulate concrete ingredients and a liquid component is directly related to the volume of the liquid

5   component added. In other words, the slump of the mix in the barrel at that time is related to the driving force required to rotate the mixing barrel. Thus, the method and apparatus monitors the torque loading on the driving means used to rotate the mixing barrel so that the mix may be optimized by adding a sufficient volume of liquid component in attempt to approach a

10   predetermined minimum torque loading related to the amount of the particulate ingredients in the mixing barrel.

More specifically, sensors are used to determine the torque loading. The magnitude of the torque sensed may then be monitored and the results stored in a storage means. The store means can subsequently be accessed

15   to retrieve information therefrom which can be used, in turn, to provide processing of information relating to the mix. In one case, it may be used to provide a report concerning the mixing.

Improvements related to sensing and determining slump are desirable.

Other methods and systems for remotely monitoring sensor data in

20   delivery vehicles are disclosed in U.S. Patent No. 6,484,079 (the '079 patent), the disclosure of which is also hereby incorporated herein by reference. These systems and methods remotely monitor and report sensor data associated with a delivery vehicle. More specifically, the data is collected and recorded at the delivery vehicle thus minimizing the

bandwidth and transmission costs associated with transmitting data back to a dispatch center. The '079 patent enables the dispatch center to maintain a current record of the status of the delivery by monitoring the delivery data at the delivery vehicle to determine whether a transmission event has

5   occurred. The transmission event provides a robust means enabling the dispatch center to define events that mark the delivery progress. When a transmission event occurs, the sensor data and certain event data associated with the transmission event are preferably transmitted to the dispatch center. This enables the dispatch center to monitor the progress

10   and the status of the delivery without being overwhelmed by unnecessary information. The '079 patent also enables data concerning the delivery vehicle and the materials being transported to be automatically monitored and recorded such that an accurate record is maintained for all activity that occurs during transport and delivery.

15   The '079 patent remotely gathers sensor data from delivery vehicles at a dispatch center using a highly dedicated communications device mounted on the vehicle. Such a communications device is not compatible with status systems used in the concrete industry.

Improvements related to monitoring sensor data in delivery vehicles

20   using industry standard status systems are desirable.

Summary of the Invention

Generally, the present invention provides a system for calculating and reporting slump in a delivery vehicle having a mixing drum and hydraulic

-4-

drive for rotating the mixing drum. The system includes a rotational sensor

mounted to the mixing drum and configured to sense a rotational speed of

the mixing drum, a hydraulic sensor coupled to the hydraulic drive and

configured to sense a hydraulic pressure required to turn the mixing drum,

5   and a communications port configured to communicate a slump calculation

to a status system commonly used in the concrete industry. The rotational

speed of the mixing drum is used to qualify a calculation of current slump

based on the hydraulic pressure required to turn the mixing drum. A

processor may be electrically coupled to the rotational sensor and the

10   hydraulic sensor and configured to qualify and calculate the current slump

based on the hydraulic pressure required to turn the mixing drum.

The delivery vehicle may further include a liquid component source,

while the system further includes a flow meter and flow valve coupled to

the liquid component source. The processor is also electrically coupled to

15   the flow meter and the flow valve and is configured to control the amount

of a liquid component added to the mixing barrel to reach a desired slump.

Various additional objectives, advantages, and features of the

invention will become more readily apparent to those of ordinary skill in the

art upon review of the following detailed description of the preferred

20   embodiments taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is block diagram of a system for calculating and reporting slump in a delivery vehicle constructed in accordance with a preferred embodiment of the invention;

5   Fig. 2 is a flow chart showing the interaction between the central dispatch center, the status system, and the RSP of Fig. 1; and

Fig. 3 is a flow chart showing an automatic mode for the RSP in Fig. 1.

Detailed Description of the Preferred Embodiments

10   Referring to Fig. 1, a block diagram of a system 10 for calculating and reporting slump in a delivery vehicle 12 is illustrated. Delivery vehicle 12 includes a mixing drum 14 for mixing concrete having a slump and a motor or hydraulic drive 16 for rotating the mixing drum 14, as indicated by double arrow 18. System 10 comprises a rotational sensor 20 installed

15   directly on or mounted to the mixing drum 14 and configured to sense the rotational speed and direction of the mixing drum 14 and a hydraulic sensor coupled to the motor or hydraulic drive 16 and configured to sense a hydraulic pressure required to turn the mixing drum 14.

System 10 further comprises a processor or ready slump processor

20   (RSP) 24 including a memory 25 electrically coupled to the hydraulic sensor 22 and the rotational sensor 20 and configured to qualify and calculate the current slump of the concrete in the mixing drum 14 based the rotational speed of the mixing drum and the hydraulic pressure required to turn the

mixing drum, respectively. The RSP 24, using memory 25, may also utilize the history of the rotational speed of the mixing drum 14 to qualify a calculation of current slump.

A communications port 26, such as one in compliance with the RS

5   485 modbus serial communication standard, is configured to communicate the slump calculation to a status system 28 commonly used in the concrete industry, such as, for example, TracerNET, which, in turn, wireless communicates with a central dispatch center 44.

Delivery vehicle 12 further includes a water supply 30 while system

10   10 further comprises a flow valve 32 coupled to the water supply 30 and configured to control the amount of water added to the mixing drum 14 and a flow meter 34 coupled to the flow valve 32 and configured to sense the amount of water added to the mixing drum 14. RSP 24 is electrically coupled to the flow valve 32 and the flow meter 34 so that the RSP 24

15   may control the amount of water added to the mixing drum 14 to reach a desired slump.

Similarly, and as an alternative or an option, delivery vehicle 12 may further includes a superplasticizer (SP) supply 36 while system 10 may further comprises a SP flow valve 38 coupled to the SP supply 36 and

20   configured to control the amount of SP added to the mixing drum 14 and a SP flow meter 40 coupled to the SP flow valve 38 and configured to sense the amount of SP added to the mixing drum 14. RSP 24 is also electrically coupled to the SP flow valve 38 and the SP flow meter 40 so that the RSP

24 may control the amount of SP added to the mixing drum 14 to reach a desired slump.

System 10 may also further comprise an optional external display, such as display 42. Display 42 actively displays RSP 24 data, such as

5   slump values, and may be used by the status system 28 for wireless communication from central dispatch center 44 to the delivery site.

A manual override 46 allows the delivery vehicle 12 to be operated manually, i.e., without the benefit of system 10.

In a preferred embodiment of the present invention, all flow sensors

10   and flow control devices, e.g., flow valve 32, flow meter 34, SP flow valve 38, and SP flow meter 40, are contained in an easy-to-mount manifold 48 while the external sensors, e.g., rotational sensor 20 and hydraulic pressure sensor 22, are provided with complete mounting kits including all cables, hardware and instructions. Varying lengths of interconnects 50 may be

15   used between the manifold 48, the external sensors 20, 22, and the RSP 24. Thus, this preferred embodiment of the present invention provides a modular system 10.

In operation, the RSP 24 manages all data inputs, e.g., drum rotation, hydraulic pressure, and water and SP flow, to calculate current slump and

20   determine when and how much water and/or SP should be added to the concrete in mixing drum 14, or in other words, to a load. The RSP 24 also controls the water flow valve 32, an optional SP flow valve 38, and an air pressure valve (not shown). The RSP 24 also automatically records the

slump at the time the concrete is poured to document the delivered product quality.

The RSP 24 has three operational modes: automatic, manual and override. In the automatic mode, the RSP 24 adds water and/or SP to adjust slump automatically. In the manual mode, the RSP 24 automatically calculates slump, but an operator is required to instruct the RSP 24 to make any additions, if necessary. In the override mode, all control paths to the RSP 24 are disconnected, giving the operator complete responsibility for any changes and/or additions. All overrides are documented by time and location.

Referring to Fig. 2, a flow chart 52 describing the interaction between the central dispatch center 44, the status system 28, and the RSP 24 in Fig. 1 is shown. More specifically, flow chart 52 describes a process for coordinating the delivery of a load of concrete at a specific slump. The process begins in block 54 wherein the central dispatch center 44 transmits specific job ticket information via its graphic position sensor (GPS)-based status system 28 to the delivery vehicle's 12 on-board computer. The job ticket information may include, for example, the job location, amount of material or concrete, and the customer-specific or desired slump.

Next, in block 56, the status system 28 on-board computer activates the RSP 24 providing all job ticket information, e.g., the job location, amount of material or concrete, and the customer-specific or desired slump, as well as delivery vehicle 12 location and speed.

In block 58, the RSP 24 continuously interacts with the status system 28 to report accurate, reliable product quality data back to the central dispatch center 44. Product quality data may include the exact slump level reading at the time of delivery, levels of water and/or SP added to the concrete during the delivery process, and the amount, location and time of concrete delivered. The process 52 ends in block 60.

Referring to Fig. 3, a flow chart 62 describing an automatic mode 64 for the RSP 24 in Fig. 1 is shown. In automatic mode 64, the RSP 24 automatically incorporates specific job ticket information from the central dispatch center 44, delivery vehicle 12 location and speed information from the status system 28, and product information from delivery vehicle 12 mounted sensors, e.g., rotational sensor 20 and hydraulic pressure sensor 22. The RSP 24 then calculates current slump as indicated in block 66.

Next, in block 68, the current slump is compared to the customer-specified or desired slump. If the current slump is not equal to the customer-specified slump, a liquid component, e.g., water or SP, is automatically added to arrive at the customer-specified slump. More specifically, in block 70 water is added, while, in block 74, a SP is added. Once water or a SP is added, the amount of water or SP added is documented, as indicated in blocks 72 and 76, respectively. Control is then looped back to block 66 wherein the current slump is again calculated.

Once the current slump is substantially equal to the customer-specified or desired slump in block 68, the load may be delivered and control is passed to block 78. In block 78, the slump level of the poured

-10-

product is captured and reported, as well as the time, location and amount of product delivered. Automatic mode 64 ends in block 80.

5

10

While the present invention has been illustrated by a description of preferred embodiments and while these embodiments have been described in some detail, it is not the intention of the Applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications other than those specifically mentioned herein will readily appear to those skilled in the art. This has been a description of the present invention, along with the preferred methods of practicing the present invention as currently known. However, the invention itself should only be defined by the appended claims, wherein I claim:

1.   A system for calculating and reporting slump in a delivery vehicle having a mixing drum and hydraulic drive for rotating the mixing drum, comprising:

a rotational sensor mounted to the mixing drum and configured to

5   sense a rotational speed of the mixing drum;

a hydraulic sensor coupled to the hydraulic drive and configured to sense a hydraulic pressure required to turn the mixing drum; and

a communications port configured to communicate a slump calculation to a status system commonly used in the concrete industry;

10   wherein the sensing of the rotational speed of the mixing drum is used to qualify a calculation of current slump based on the hydraulic pressure required to turn the mixing drum.

2.   The system of claim 1, wherein the history of the rotational speed of the mixing drum is used to qualify a calculation of current slump.

3.   The system of claim 1, further comprising a processor electrically coupled to the hydraulic sensor and the rotational sensor and configured to qualify and calculate the current slump based on the rotational speed of the mixing drum and the hydraulic pressure required to turn the mixing drum.

4.   The system of claim 3, wherein the delivery vehicle further includes a liquid component source and the system further comprises:

a flow valve coupled to the liquid component source and configured to control the amount of a liquid component added to the mixing drum; and

a flow meter coupled to the flow valve and configured to sense the amount of liquid component added to the mixing drum;

the processor electrically coupled to the flow valve and the flow meter;

wherein the processor controls the amount of liquid component added to the mixing drum to reach a desired slump.

5.   The system of claim 4, wherein the liquid component is at least one of water and a superplasticizer (SP).

6.   The system of claim 4, wherein the flow valve and the flow meter are mounted in a manifold, the rotational sensor and the hydraulic pressure sensor are provided with mountings, and varying lengths of interconnects are used between the manifold, the rotational sensor and the hydraulic pressure sensor to provide a modular system.

7.   The system of claim 3, further comprising a display coupled to the processor and configured to display slump values.

8. A method of calculating and reporting slump in a delivery vehicle having a mixing drum and a hydraulic drive for rotating the mixing drum, comprising:

sensing a rotational speed of the mixing drum;

sensing a hydraulic pressure required to turn the mixing drum;

using the sensed rotational speed of the mixing drum to qualify a calculation of slump;

calculating a current slump based on the sensed hydraulic pressure required to turn the mixing drum; and

communicating a slump calculation to a status system commonly used in the concrete industry.

9.   The method of claim 8, further comprising using the history of the rotational speed of the mixing drum to qualify a calculation of current slump.

10.   The method of claim 8, wherein the delivery vehicle further includes a liquid component source and the method further comprises:

        controlling the amount of liquid component added to the mixing drum; and

        sensing the amount of liquid component added to the mixing drum to reach a desired slump.

11.   The method of claim 10, wherein the liquid component is at least one of water and a superplasticizer (SP).

12.   The method of claim 8, further comprising displaying the current slump.

13.   The method of claim 8, further comprising comparing the current slump to a desired slump.

METHOD AND SYSTEM FOR CALCULATING AND REPORTING SLUMP IN DELIVERY VEHICLES

Abstract of the Disclosure

A system for calculating and reporting slump in a delivery vehicle having a mixing drum and hydraulic drive for rotating the mixing drum, including a rotational sensor mounted to the mixing drum and configured to sense a rotational speed of the mixing drum, a hydraulic sensor coupled to

5   the hydraulic drive and configured to sense a hydraulic pressure required to turn the mixing drum, and a communications port configured to communicate a slump calculation to a status system commonly used in the concrete industry, wherein the sensing of the rotational speed of the mixing drum is used to qualify a calculation of current slump based on the

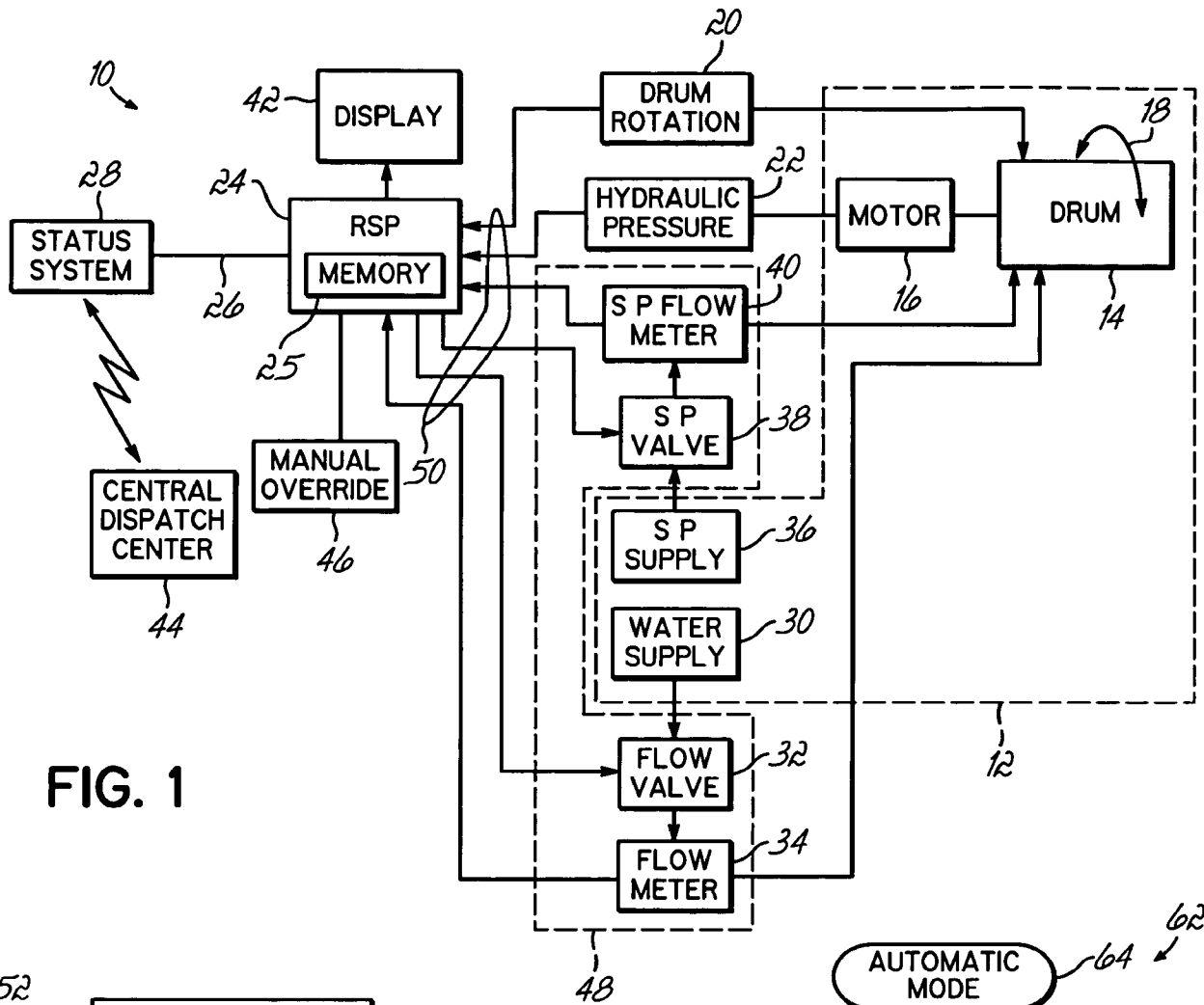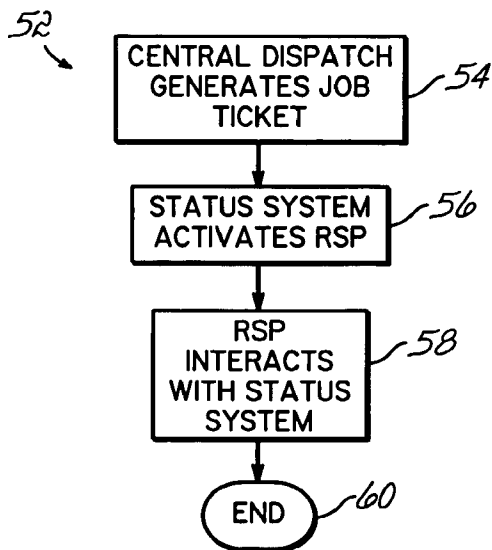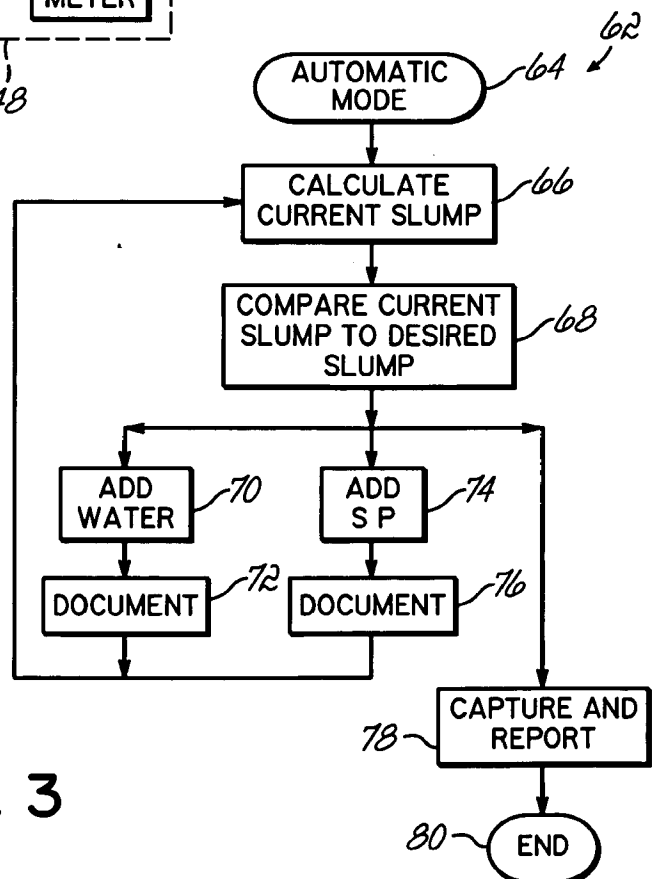10   hydraulic pressure required to turn the mixing drum.

FIG. 1

- 10
- 42 — DISPLAY
- 24 — RSP
- 25 — MEMORY
- 28 — STATUS SYSTEM
- 26
- 46 — MANUAL OVERRIDE
- 44 — CENTRAL DISPATCH CENTER
- 50
- 20 — DRUM ROTATION
- 22 — HYDRAULIC PRESSURE
- 40 — S P FLOW METER
- 38 — S P VALVE
- 36 — S P SUPPLY
- 30 — WATER SUPPLY
- 32 — FLOW VALVE
- 34 — FLOW METER
- 16 — MOTOR
- 18 — DRUM
- 14
- 12
- 48

FIG. 2

- 52
- 54 — CENTRAL DISPATCH GENERATES JOB TICKET
- 56 — STATUS SYSTEM ACTIVATES RSP
- 58 — RSP INTERACTS WITH STATUS SYSTEM
- 60 — END

FIG. 3

- 62
- 64 — AUTOMATIC MODE
- 66 — CALCULATE CURRENT SLUMP
- 68 — COMPARE CURRENT SLUMP TO DESIRED SLUMP
- 70 — ADD WATER
- 72 — DOCUMENT
- 74 — ADD S P
- 76 — DOCUMENT
- 78 — CAPTURE AND REPORT
- 80 — END